



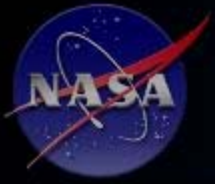
# Small Spacecraft Industry Day

June 27, 2007



# Agenda

- 8:15 Welcome
- 8:20 Partnering with NASA
- 8:30 SBIR/STTR Overview
- 8:45 Overview of Small Spacecraft Initiatives
- 9:30 System Engineering & Integration
- 10:00 Small Spacecraft Avionics
- 10:30 Break
- 11:00 Attitude Control & Propulsion Systems
- 11:30 Innovative Ground & Small Spacecraft Operations
- 12:00 Autonomous Software, Algorithms and Data Mgmt
- 12:30 Lunch
- 1:00 – 4:30 One-on-One Meetings with Ames Community



# Partnering with NASA

*Rich Pisarski*  
NASA Ames Research Center





# **NASA Mission Directorates**

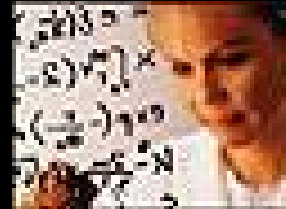


# NASA Mission Directorates



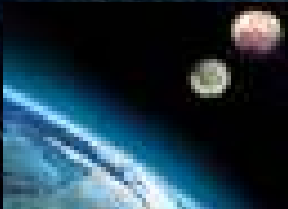
## Aeronautics

Enable a safer, more secure, efficient, and environmentally friendly air transportation system



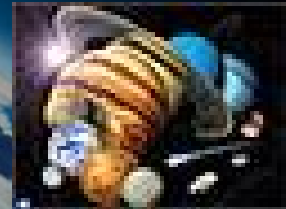
## Science

Exploring the Earth-Sun system, our own solar system, and the universe beyond.



## Exploration Systems

Direct the identification, development and validation of exploration systems and technologies.



## Space Operations

Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.



# **NASA Ames Research Center**





# NASA Ames

Founded in 1939, NASA Ames leverages its Silicon Valley location and innovative partnerships with cutting-edge industries and leading universities to conduct applied research and produce critical-path technologies that enable NASA missions.







# Technology Areas



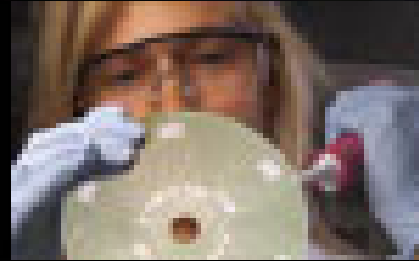
**Aerospace and  
Aeronautics**



**Robotics and Artificial  
Intelligence**



**BioTech/Bio-Medical**



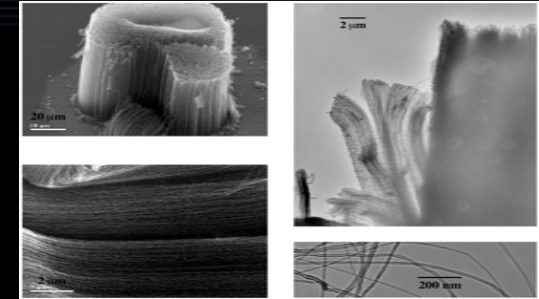
**Integrated Systems Health  
Management (ISHM)**



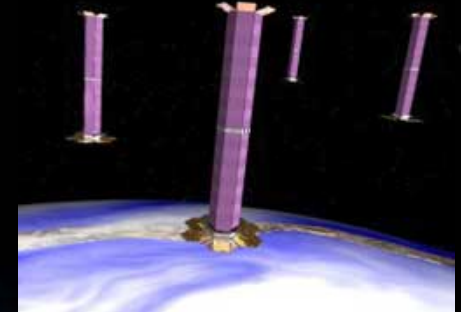
**Systems Engineering  
and Design**



**Materials Science  
and Entry Systems**



**Advanced Materials & Devices**



**Small Satellite Systems**



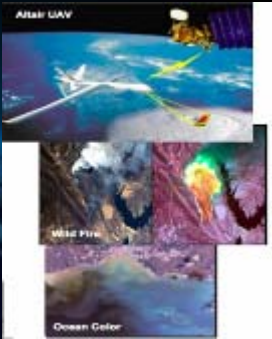
**Software and  
High-end Computing**





# Aerospace & Aeronautics

**Airborne Sensor Facility**



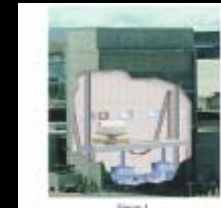
**3% Space Shuttle Model**



**Aeromechanics Branch**



**Aerospace Simulation Operations Branch**



**Air Traffic Management**



**Autonomous Flight Systems Branch**



**Flight Control Optimization**



**SOAREX – Sub-Orbital Aerodynamic Re-Entry Experiments**

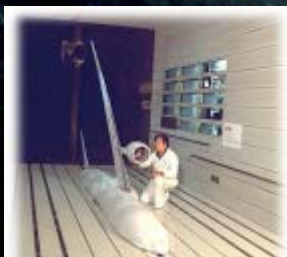


<http://aeronautics.arc.nasa.gov/>

**VMS - Vertical Motion Simulator**



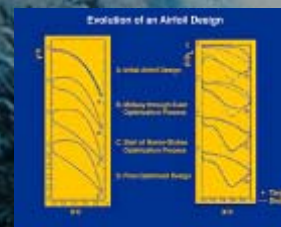
**Wind Tunnel Support for Space Exploration**



**System Design and Technology Assessment**



**Neural Network Based Aerodynamic Design Optimization**



**Future Flight Central**







# Autonomy Intelligence & Robotics

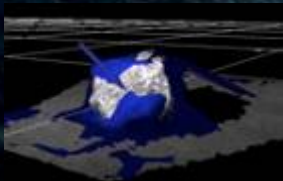
**Moon and Mars Analog Mission Campaigns**



**Mobile Agents**



**Machine Vision for Robotics**



**Field Robotics**



**Advanced Rover Prototype  
K9 Rover Control Software**



**Spatial Standard Observer**



**Adaptive Control  
Technology**



**Advanced Teleoperation  
Interfaces**



**Autonomous Spacecraft  
Free-Flying Robots**



**Intelligent Launch and  
Range Operations**



**High Resolution Human  
Performance Modeling  
for Human-Robotic  
Teaming**



**Evolvable Systems  
Technology**



**Intelligent Systems**

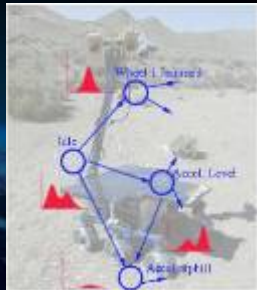




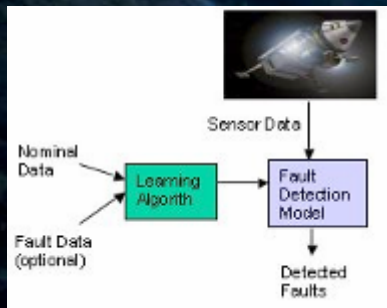


# Integrated Systems Health Mgmt

## Diagnosis of Complex Systems

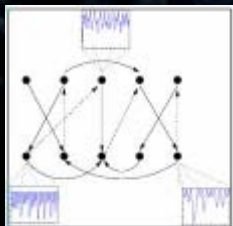


## Data Mining and Complex Systems Design for ISHM

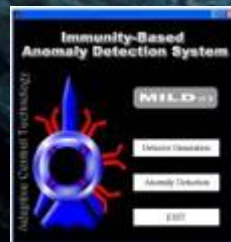


<http://ic.arc.nasa.gov/index.php>

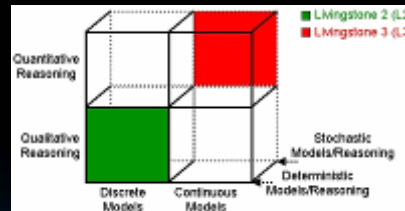
## Prognostic Tools for Complex Dynamical Systems



## Multi-Level Immune Learning Detection



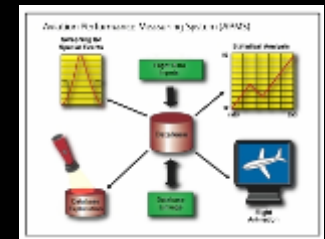
## Advanced Methods for Model-based Diagnosis and Recovery



## Inductive Monitoring - Automated Monitoring Techniques for Complex Systems



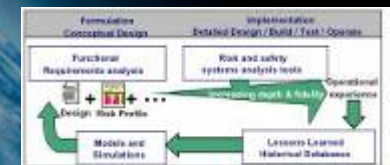
## Aviation Performance Measuring System



## Intelligent Spacecraft Interface Systems Laboratory



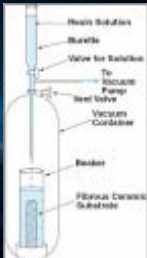
## Design Principles for Robust ISHM



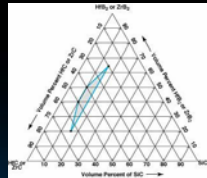


# Materials Science & Entry Systems

Low-Density, Ablative Resin-Impregnated Ceramic Insulation



High Temperature Resistant Zirconium and hafnium Ceramics



Chemistry Modeling of Ablative TPS



Protective Coatings for Ceramic Materials



High Temperature Black Lightweight Advanced Ceramic Insulation



Space Radiation Effects on Materials



Toughened Uni-Piece Fibrous Insulation



High Temperature Resistant Organopolysiloxane Coatings



Chemical Vapor Deposition for Thin Films for Waterproofing



Method for Waterproofing Ceramic Materials



Thermal Protection Materials Development



<http://asm.arc.nasa.gov/>





# Technology Partnership Overview



# Technology Partnerships Office

## Goals

- Creates strategic collaborations with:
  - Industry
  - Academia
  - Government agencies
  - National laboratories
- Manages ARC intellectual property portfolio
  - Enables innovative technology development for NASA missions and US public benefit

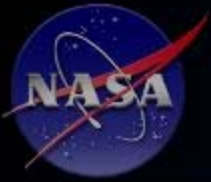




# Technology Partnerships Office

## Expected Benefits

- Increased range of technology solutions
- Broadened technology portfolio
- Improved cost avoidance
- Patent license revenue
- Accelerated maturation of technologies
- Increased pool of commercial providers
- Reduced time to market



# Tech Partnership Services

- Provide business development access to ARC
- Manage IP and tech-transfer
- Create a portal to emerging NASA technology
- Facilitate and structure partnership deals
- Orchestrate public interaction - internal and external



<http://technology.arc.nasa.gov/>





# Partnering with NASA



# NASA Partnership Options

## Space Act Agreements

- Non-Reimbursable
- Reimbursable
- Memorandum of Understanding
- Memorandum of Agreement
- Interagency
- Licensing Agreements
  - Exclusive
  - Nonexclusive
  - Limited exclusive
- Software Agreements
- Cooperative Research & Development Agreements (CRDA)
- Cooperative Agreements





# Working With NASA

## The Innovative Partnership Program (IPP) Seed Fund

- Provides seed funding to initiate cost-shared, joint development partnerships with non-NASA partners
  - Develop an increased range of technology solutions,
  - Accelerate development and maturation of technologies
  - Larger pool of commercial providers
- Work is aligned with NASA's missions
- \$250K max from IPP with matching non-NASA funds (\$9.2M FY07)

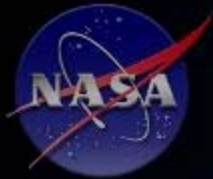
Small Business Innovative Research (SBIR) Program

Small Business Technology Transfer (STTR) Program



# Ames Partnerships





# Ames Industry Partners

**GENERAL DYNAMICS**  
*Strength On Your Side®*

**Google™**

**NORTHROP GRUMMAN**

**Genentech**  
IN BUSINESS FOR LIFE

**Raytheon**

**COATRON**

**ORACLE®**

**Honeywell**

**BOEING**

**ERICSSON**  
TAKING YOU FORWARD

**TEXTRON**

**Microsoft**

**CHIRON**

**BAE SYSTEMS**

**LOCKHEED MARTIN**  
*We never forget who we're working for™*

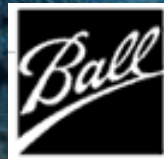
**CISCO SYSTEMS**

**Sikorsky**  
A United Technologies Company



**HARRIS**

**DELL™**



**CH2MHILL**

**Vought®**  
Aircraft Industries, Inc.

**GE** imagination at work

**Bloomenergy™**

**Bell Helicopter**  
A Textron Company

**CATERPILLAR®**

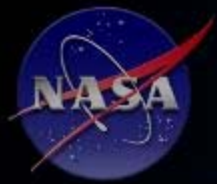
**EADS**

**Lucent Technologies**  
Bell Labs Innovations

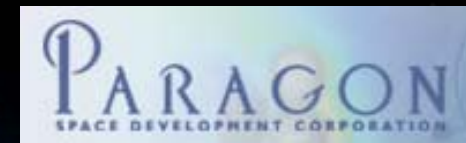
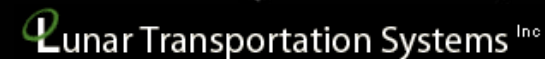
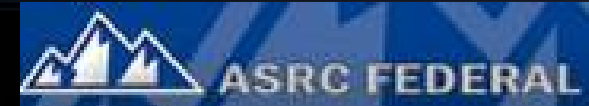


**Rockwell Collins**

**Pratt & Whitney**  
A United Technologies Company



# Emerging Commercial Space Companies Working with Ames







# Ames NRP Partnerships



Global System Awareness and Adaptive Control



IntelligenTek Corp.



Carnegie Mellon

CAL POLY



Santa Clara University





# Contact Information

<http://technology.arc.nasa.gov/>

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**Questions?**